

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

STREAM CROSSING, (NO.)

CODE 578

DEFINITION

A stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles.

PURPOSE

- Improve water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream.
- Reduce streambank and streambed erosion.
- Provide crossing for access to another land unit.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where an intermittent or perennial watercourse exists and a ford, bridge, or culvert type crossing is desired for livestock, people, and /or equipment.

CRITERIA

Location. Stream crossings shall be located in areas where the streambed is stable. Avoid sites where channel grade or alignment changes abruptly, excessive seepage or instability is evident, overfalls exist, or large tributaries enter the stream. Wetland areas shall be avoided if at all possible. If impact to wetlands cannot be avoided, follow Natural Resources Conservation Service (NRCS) wetland policy and procedures and Corps of Engineers (COE) requirements.

Locate crossings, where possible, out of shady riparian areas to discourage cattle loafing time in the stream. Selectively remove trees and prune limbs to reduce shade.

Crossings shall be installed perpendicular to the direction of the flow of the stream. On sites where this is impossible, additional armoring, both

upstream and downstream, shall be provided to protect the stream bed and banks from erosion due to the skewed alignment.

Stream crossings shall provide a way for normal passage of water, fish and other aquatic animals within the channel during all seasons of the year.

Access Roads. Where high rates of erosion of the adjacent roadways that slope towards the crossing threaten to deliver an excessive amount of sediment to the drainage, install measures to minimize erosion of the roadside ditch, road surface, and/or cut slopes. Where the stream crossing is installed as part of a roadway, the crossing shall be in accordance with Alabama NRCS Conservation Practice Standard, 560, Access Road.

Width. The stream crossing shall provide an adequate travel-way width for the intended use. A multi-use stream crossing shall have a travel-way no less than 10 feet wide and no more than 20 feet wide. Livestock-only crossings shall be no less than 6 feet wide. Width shall be measured from the upstream edge to the downstream edge of the stream crossing and shall not include the side slopes.

Side Slopes. All cuts and fills for the stream crossing shall have side slopes that are stable for the soil involved. Side slopes of earth cuts or fills shall be no steeper than 2.5 horizontal to 1 vertical. Rock cuts or fills shall be no steeper than 1.5 horizontal to 1 vertical.

Stream Approaches. Approaches to the stream crossing shall blend with existing site conditions where possible, and shall not be steeper than 5 horizontal to 1 vertical. Unless the foundation geology is otherwise acceptable, the approaches shall be stable, have a gradual ascent or descent grade, and be underlain with suitable material, as necessary, to withstand repeated and long-

term use. The minimum width of the approaches shall be equal to the width of the crossing surface.

Surface runoff shall be diverted around the approaches to prevent erosion of the approaches. Roadside ditches shall be directed into a diversion or away from the crossing surface.

Rock. All rock shall be chosen to withstand exposure to air, water, freezing, and thawing. When rock is used, it shall be sufficiently large and dense so that it is not mobilized by design flood flows.

Fencing. Areas adjacent to the stream crossing shall be permanently fenced or otherwise excluded as needed to manage livestock access to the crossing.

Cross-stream fencing at fords shall be accomplished with breakaway wire, swinging floodgates, hanging electrified chain or other devices to allow the passage of floodwater debris during high flows.

All fencing shall be designed and constructed in accordance with Alabama NRCS Conservation Practice Standard 382, Fence.

Vegetation. All areas to be vegetated shall be planted as soon as practical after construction. When necessary, use of Alabama NRCS Conservation Practice Standard 342, Critical Area Planting, shall be considered where vegetation is unlikely to become established by natural regeneration, or acceleration of the recovery of vegetation is desired.

Criteria for Culvert and Bridge Crossings

Design of culverts and bridges shall be consistent with sound engineering principles and shall be adequate for the use, type of road, or class of vehicle. Culverts and bridges shall have sufficient capacity to convey the design flow without appreciably altering the stream flow characteristics.

Culverts shall be sized to handle at least the bankfull flow or the peak runoff from the 2-year, 24-hour peak discharge, whichever is less. Crossings shall be adequately protected so that out-of-bank flows safely bypass without structure or streambank damage, or erosion of the crossing fill. Additional culverts may be used at various elevations to maintain terrace or floodplain hydraulics.

The length of the culvert shall be adequate to extend the full width of the crossing, including side slopes. At least one culvert pipe shall be placed on or below grade with the existing stream bottom.

Compacted fill will be used to form the crossing. The minimum depth of compacted fill over the culvert shall be equal to one-half the diameter of the culvert, or 24 inches, whichever is greater. The compacted fill shall be built up over the culvert so that any stream overflow will cross the road at a point away from the culvert. The compacted fill and pipe outlet shall be protected from erosion if needed with riprap. The total thickness of riprap shall be at least 18 inches. A concrete headwall or grouted riprap may be required in cases of severe attack. The driving surface over culverts shall be topped with Class II non-woven geotextile and a minimum 6 inches of AASHTO No. 1 coarse aggregate or other suitable materials.

Acceptable culvert materials include concrete, corrugated metal, corrugated plastic, new or used high quality steel, and other materials approved by the engineer.

Acceptable bridge materials include concrete, steel, and wood.

Criteria for Ford Crossings

When ford crossings are used, the cross-sectional area of the crossing shall not be less than the natural channel cross-sectional area. A portion of the crossing shall be depressed at or below the average stream bottom elevation when needed to keep base flows or low flows concentrated.

Cutoff walls shall be provided at the upstream and downstream edges of ford-type stream crossings when needed to protect against undercutting.

The finished top surface of the ford type stream crossing in the bottom of the watercourse shall be no higher than the original stream bottom at the upstream and downstream edge of the ford crossing.

Where rock is used for ford-type stream crossings for livestock, use a hoof contact zone or alternative surfacing method over the surfacing rock. This zone could include crushed limestone, rock screenings, crusher

run, or similar materials and shall cover the entire rock surface. Generally, 4 inches of hoof contact zone is necessary. This material does not have to meet any velocity criteria. This layer is expected to be replaced periodically by the landowner as livestock traffic or runoff events erode the surface material.

Concrete Fords

Concrete ford crossings will only be approved by the state conservation engineer. Concrete ford crossings shall be used only where the foundation of the stream crossing is determined to have adequate bearing strength.

Stream flow will be diverted during the placement of concrete. Concrete shall have a minimum compressive strength of 3,000 psi at 28 days. Concrete ford crossings shall have a minimum thickness of placed concrete of 5 inches with minimum reinforcement of 6-inch by 6-inch, 6 gauge welded wire fabric. The concrete slab shall be poured on a minimum 4-inch thick rock base, unless the foundation is otherwise acceptable.

Precast concrete panels may be used in lieu of cast-in-place concrete slabs. Precast concrete units shall comply with ACI 525 or 533, or as otherwise acceptable for local conditions.

When heavy equipment loads are anticipated, the concrete slab shall be designed using an appropriate procedure as described in American Concrete Institute, ACI 360, Design of Slabs on Grade.

Geocell and/or Rock Ford Crossings

Rock ford crossings with geotextile shall be used when the site has a soft or unstable subgrade. Geotextile filter cloth shall be a non-woven, needle-punched geotextile material with a minimum tensile strength of 120 pounds. Ford crossings made of stabilizing material such as rock riprap are often used in steep areas subject to flash flooding, where normal flow is shallow or intermittent.

The bed of the channel shall be excavated to the necessary depth and width and covered with geotextile material. The geotextile material shall be installed on the excavated surface of the ford and shall extend across the bottom of the stream and at least up to the 10-year, 24-hour peak discharge elevation or at least a 20 ft. distance.

If using geocells, the cells shall be at least 6 inches deep. All geosynthetic material shall be suitably durable and shall be installed in accordance with the manufacturer's recommendations, including the use of staples, clips and anchor pins.

The stream crossing must be designed to remain stable during either the bank full event or the peak runoff from a 10-year, 24-hour event, whichever is less. Channel velocities shall be computed or measured, and a stone size chosen from Table 578-1.

Table 578-1. Maximum velocity and D_{50} sizes

Maximum Velocity (fps)	D_{50}^* (inches)
2.7	0.5
3.2	1.0
4.3	2.0
5.3	3.0
6.3	4.0

*Diameter of stone such that 50% (by weight) of the stones are smaller.

The thickness of the stone layer shall be at least 8 inches. When larger stone than D_{50} of 4 inches is used for convenience, the minimum thickness will be $1.5 \times D_{50}$.

Geocell material shall not be used if velocities are expected to exceed 5 fps.

CONSIDERATIONS

Avoid or minimize stream crossings, when possible, through evaluation of alternative trail or travel-way locations.

Ford crossings have the least detrimental impact on water quality when crossing is infrequent. Ford crossings are adapted for crossing wide, shallow watercourses with firm streambeds.

High stream banks result in large excavated areas for 5:1 approaches for ford crossings and can be unsightly.

When using geocell in soft stream bottoms with heavy equipment crossing the ford, consider over excavating the stream bottom and installing geotextile and rock as a foundation for the geocell.

For heavily used areas, consider using a culvert instead of a ford. However, culverts are not recommended for large drainage areas. Evaluate each specific site carefully to determine if a ford or culvert is most appropriate.

Stream crossings should be located where adverse environmental impacts will be minimized and considering the following:

- Effects on up-stream and down-stream flow conditions that could result in increases in erosion, deposition, or flooding.
- Short term and construction-related effects on water quality.
- Effects on fish passage and wildlife habitats.
- Effects on cultural resources.
- Overall effect on erosion and sedimentation that will be caused by the installation of the crossing and any necessary stream diversion.

Where stream crossings are used, evaluate the need for safety measures such as guardrails at culvert or bridge crossing, or water depth signage at ford crossings.

PLANS AND SPECIFICATIONS

Plans and specifications for stream crossings shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and implemented for the life of the practice.

The stream crossing, appurtenances, and associated fence should be inspected after each major storm event, with repairs made as needed.

REFERENCES

Alabama NRCS Conservation Practice Standards

Access Road – 560

Critical Area Planting – 342

Fence – 382

Alabama NRCS Guide Sheet

Stone Stream Crossing – AL 578

Alabama Engineering Forms

AL-ENG-43 – Stream Crossing (Ford) – Geotextile and Stone

AL-ENG-44 – Stream Crossing (Ford – “Geocell”

AL-ENG-47 – Electrified Flood Gate at Stream Crossing

CONSTRUCTION SPECIFICATION

NATURAL RESOURCES CONSERVATION SERVICE

STREAM CROSSING

1. SCOPE

This item shall include all plans, specifications and construction operations required for the installation of stream crossings. Construction operations shall be carried out in such a manner that erosion, air, water, and noise pollution will be minimized within legal limits as established by state regulations.

2. SPECIFICATIONS

Clearing and Grubbing

Clearing and grubbing shall be kept to the minimum needed in order to install the structure. All trees and brush shall be removed from the area before excavation starts. The foundation shall be cleared of all stumps, roots, brush, sod, and other debris. All waste materials shall be disposed of in a sightly and work-man-like manner in a designated area outside the natural floodway. Limbs shall be pruned around ford crossings which have free access by cattle in order to minimize shade in the crossing.

Foundation Excavation

All material shall be removed from the foundation of the stream crossing to the depths, widths, and lengths required by the design. Excavation may be limited to one side of the stream at a time in order to facilitate diversion of the stream. It may be advantageous to divert the stream flows around the site using a pipe or ditch. The stream may also be temporarily impounded during construction. Note, however, that stream diversion during construction shall be conducted in a manner that minimizes erosion and sedimentation.

For ford construction, trenches at least 1 ft. wide and 2 ft. deep shall be excavated on both the upstream and downstream sides of the stream crossing bottom and transition on 1H to 1V slopes.

Diversions

Diversions and side ditches shall conform to the lines, grades, and sections as specified on the plans.

Geotextile Filter Cloth (for Fords)

Geotextile filter cloth shall be a non-woven needle-punched geotextile material with a minimum tensile strength of 120 lbs. (minimum average roll value).

A geotextile filter cloth shall be installed under the entire crossing as well as in the toe trenches.

Longitudinal ends of the geotextile filter cloth shall be lapped back over the top of the backfill toe trench a minimum of one foot beyond the edge of the trench and anchored to the fabric using anchoring pins placed on five foot centers. When more than one width of cloth is required, the downstream panel shall be installed first. The next upstream panel shall be installed with a minimum of 18 inches overlap over the first section. Anchoring pins shall be installed on 3-foot centers, 6 inches from the downstream edge of the lap. Pins shall penetrate both sections of cloth in the lap.

Every precaution shall be taken not to tear the geotextile filter cloth. Tears shall be repaired immediately by removing all surface material and soil from the tear for a minimum distance of 18 inches in all directions of the tear. Spread a new section of cloth over the cleared area and anchor with anchoring pins around all sides.

Where stream channels are composed of a stable coarse rocky material or solid bedrock, the requirement to extend fabric filter cloth across the channel bottom may be waived upon the approval of the engineer.

Anchoring Pins for Geotextile

Anchoring pins shall be fabricated using No. 3 reinforcing steel or material of equivalent or greater size and durability and shaped as shown on the drawings. All anchor pins shall be installed with the top width lying perpendicular to the direction of flow in the stream. Pins shall be driven vertically into undisturbed soil to provide maximum resistance to removal.

Anchoring pins shall be placed through the filter cloth at all excavated trenches on approximately 3-foot centers. Pins shall be installed through all overlapped fabric and across the width of the channel bottom on approximately 3 foot centers. For crossings using only one width of fabric, plan to use a number of pins equal to 0.85 times the total length of the crossing from entrance to exit end. For crossings using two widths of fabric, use 1.3 times the total length.

Care shall be taken not to rip the fabric while installing anchor pins. Pins shall be sharpened to permit easy penetration through the fabric. Also, the fabric will fit tightly around anchor pins with sharpened ends. If a pin must be removed, plug the opening with a wadded ball of fabric filter cloth.

Light weight wire staples such as used to anchor mulch netting may be used to hold filter cloth in place temporarily while construction is in progress. Such staples cannot substitute for anchor pins.

Culvert pipes

Pipes shall be on a firm foundation to the neat lines and grades shown on the plans. Selected backfill shall be placed around the pipes in 4-inch layers and thoroughly compacted. Gravel can be used to bed pipe under wet conditions and the gravel shall be protected with larger stone at the upper and lower ends of the pipe.

Joints of pipe will be sealed in accordance with the manufactures' specifications. Pipes will not be laid directly on rock; there must be a soil bed or gravel cushion of at least 6 inches between the pipe and rock.

The outlet end of culverts shall terminate on the natural streambed unless protective outlet structures are installed.

Culvert materials shall be as specified by the engineer or as shown on the drawings.

Stone Aggregate

Acceptable material consisting of coarse sands and/or gravel, if present in the foundation excavation, may be stockpiled for later use in the toe trenches or on the roadway. Large washed stone or creek gravel may be used to prepare a foundation for the geotextile filter cloth in unstable soils. Coarse stone may also be used as a subgrade filler between the filter cloth and the surfacing material.

No equipment shall operate directly on the geotextile until surfacing material is spread with a minimum of 6 inches of cover over the geotextile.

Inspection

All materials shall be inspected by the technician before installation. Written certification of conformance to specifications will be required if physical inspection is not conclusive.